

## **Instructions**

This Excel workbook and the companion document *Supporting Documentation for TCEQ's Ecological Benchmark Tables* comprise RG-263b. Their intended use is to provide support to the parent document: *Conducting Ecological Risk Assessments at Remediation Sites in Texas*, TCEQ publication RG-263.

Ecological benchmarks are numerical values for chemicals of concern (COCs) in surface water, sediment, and soil and are used for comparison to site-related media concentrations associated with ecological risk assessments.

Comparison of affected property concentrations to ecological benchmarks is the first required element in a Tier 2 screening level ecological risk assessment (SLERA).

Required element 1 is specified in the Texas Risk Reduction Program (TRRP) rule [30 TAC Chapter 350.77 (c)(1)].

This required element is intended to initially identify COCs that are present at concentrations that could be causing unacceptable ecological risk.

Included in this workbook are benchmarks for inorganics in surface water, organics in surface water, hardness formulas that can be used to modify certain surface water benchmarks, sediment benchmarks, soil benchmarks, and benchmarks for radionuclides.

This table provides instructions for the Ecological Benchmark Tables.

End of Worksheet

## Summary of Updates to the Benchmark Tables Accompanying the Ecological Risk Assessment Guidance

Last revised: August, 2019

Date of Change	Media	Change Made
8/27/2019	Water	Barium freshwater acute and chronic values updated using the LC50 approach. Saltwater values were also reexamined but did not change between 2018 and 2019.
8/27/2019	Water	Beryllium freshwater acute and chronic values updated using the LC50 approach.
8/27/2019	Water	Cobalt freshwater acute and chronic values updated using the LC50 approach. Cobalt acute and chronic saltwater values also did not change between 2018 and 2019.
8/27/2019	Water	Magnesium freshwater benchmarks removed, after reconsideration of the previous values and a lack of useful scientific literature.
8/27/2019	Water	Anthracene freshwater and saltwater acute and chronic values updated using the LC50 approach. The saltwater acute benchmark did not change between 2018 and 2019.
8/27/2019	Water	"Benzo(a)anthracene" relabeled as "benz(a)anthracene," which is more consistent with the human health PCL tables (April 2018). Freshwater acute and chronic values for BaA updated using the LC50 approach.
8/27/2019	Water	Dibenz[a,h]anthracene freshwater acute and chronic values updated using the LC50 approach.
8/27/2019	Water	Chrysene freshwater benchmarks removed, after reconsideration of the previous values and a lack of useful scientific literature.
8/1/2018	All	Improved readability for printing
8/1/2018	Water	Carbaryl freshwater chronic, salt water acute and salt water chronic values updated to be consistent with Texas Surface Water Quality Criteria
8/1/2018	Water	Freshwater ammonia values corrected
8/1/2018	Water	Freshwater benchmarks for PFOS added. A surface water wildlife value protective of predatory birds is listed in the footnote.
8/1/2018	Water	All National Ambient Water Quality Criteria verified on-line: <a href="http://www.epa.gov/wqc/national-recommended-water-quality-criteria">www.epa.gov/wqc/national-recommended-water-quality-criteria</a>
8/1/2018	Water	Freshwater and saltwater chronic benchmarks for molybdenum updated
8/1/2018	Sediment	Freshwater benchmark, second effects level and benthic PCL added for PFOS
8/1/2018	Sediment	Freshwater copper benthic PCL corrected
8/1/2018	Soil	Chromium previously not identified as bioaccumulator by bold and italics text, this has been corrected
8/1/2018	Soil	1,4-dichlorobenzene identified as a volatile organic compound, previously listed under semivolatile organic compounds
8/1/2018	Soil	Benchmark for all PAHs removed and replaced with wildlife PCL

This table provides a list of all edits and additions to the Ecological Benchmark Tables from 2018 through 2019.

End of worksheet

## Surface Water Benchmarks (mg/L) for Metals, Inorganics

Chemical of Concern	note	CAS No.	Freshwater Acute Benchmark (mg/L)	note	Freshwater Chronic Benchmark (mg/L)	note	Saltwater Acute Benchmark (mg/L)	note	Saltwater Chronic Benchmark (mg/L)	note
aluminum	d	7429-90-5	0.99	a	0.087	b				
antimony		7440-36-0	6.60	f	2.20	f	2.18	f	0.73	f
ammonia (as total ammonia nitrogen)		7664-41-7	1.7	b, k	0.41	b, k				
arsenic	d	7440-38-2	0.34	a	0.15	a	0.149	a	0.078	a
barium		7440-39-3	123	f	20.5	f	150	f	25	f
beryllium		7440-41-7	0.69	f	0.11	f				
boron		7440-42-8	20.20	c	1.1	c				
cadmium	d	7440-43-9	0.0044	a, g	0.00015	a, g	0.04	a	0.00875	a
chloride		16887-00-6	860	b	230	b				
chlorine		7782-50-5	0.019	b	0.011	b	0.013	b	0.0075	b
chromium (tri)	d	16065-83-1	0.32	a, g	0.042	a, g				
chromium (hex)	d	18540-29-9	0.0157	a	0.0106	a	1.090	a	0.0496	a
cobalt		7440-48-4	0.42	f	0.07	f, p	1.00	f	0.17	f
copper	d	7440-50-8	0.00739	a, g	0.00524	a, g	0.0135	a, i	0.0036	a
cyanide (free)		57-12-5	0.0458	a, j	0.0107	a, j	0.0056	a, j	0.0056	a, j
fluoride (F <sup>-</sup> )		16984-48-8			1.94	q				
iron		7439-89-6			1	b				
lead	d	7439-92-1	0.03014	a, g	0.00117	a, g	0.133	a	0.0053	a
lithium		7439-93-2	0.258	c	0.014	c				
magnesium		7439-95-4								
manganese	d	7439-96-5	2.37	g, l	1.310	g, l, p				
<b>mercury</b>		7439-97-6	0.0024	a	0.0013	a	0.0021	a	0.0011	a
molybdenum	d	7439-98-7	60	e	36.1	n, p			3.85	n
nickel	d	7440-02-0	0.26	a, g	0.0289	a, g	0.118	a	0.0131	a
nitrate, NO <sub>3</sub> <sup>-</sup>		14797-55-8	550	m	13.0	m	1500	m	200	m
nitrite, NO <sub>2</sub> <sup>-</sup>		14797-65-0								
phosphorus, elemental		7723-14-0								
<b>selenium</b>		7782-49-2	0.02	a	0.005	a	0.564	a	0.136	a
silver, as free ion	d,o	7440-22-4	0.0008	a	0.00008	a, h	0.002	a	0.0002	a, h
silver	d	7440-22-4	0.001	b, g	0.0001	b, h	0.0019	b	0.00019	b, h
strontium		7440-24-6	14.53	c	10.7	r				

sulfide, hydrogen sulfide	7783-06-4		0.002	<b>b</b>		0.002	<b>b</b>	
<b>thallium</b>	7440-28-0	0.54	f	0.18	f	6.3	f	
tin	7440-31-5	2.68	c	0.073	c			
tributyltin (TBT)	688-73-3	0.00013	a	0.000024	a	0.00024	a	
uranium	d	7440-61-1	1.12	g, l	0.700	g, l, p		
vanadium		7440-62-2	0.284	c	0.02	c		
vanadium pentoxide		1314-62-1	0.445	e	0.015	e		
zinc	d	7440-66-6	0.0651	a, g	0.0657	a, g	0.0927	a
zirconium		7440-67-7	0.309	c	0.017	c		

This table contains surface water benchmarks for metals and other inorganic compounds.

**COCs listed in bold and italics are considered bioaccumulative.**

**a** Criteria are from Texas Surface Water Quality Standards (30 TAC 307.6, Table 1). Effective March 1, 2018.

**b** National Ambient Water Quality Criteria (verified January 2018). Note: chronic value for aluminum is **not** based on the dissolved fraction.

**c** Benchmarks from G.W. Suter, II, and C.L. Tsao. 1990. *Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota*.

**d** Revised Oak Ridge, TN, Lockheed Martin Energy Systems U.S. Department of Energy, ES/EP/TM-06/02. Value for boron recalculated due to units in error in Suter.

**d** Indicates that the benchmarks are for the dissolved portion in water. Unless noted with a *d*, criteria are for total concentrations in water.

**e** Benchmark derived by TCEQ using the LC<sub>50</sub> approach in accordance with methodology defined in the Texas Surface Water Quality Standards 30 TAC 307.6 (c)

**f** Benchmark derived by TCEQ using the LC<sub>50</sub> approach in accordance with methodology defined in the Texas Surface Water Quality Standards 30 TAC 307.6 (c)

**g** Criteria calculated using an assumed hardness of 50 mg/L as CaCO<sub>3</sub>. The hardness-based formulas are included on a separate sheet. The person should use

**h** There is only an acute criterion (no chronic criterion). The indicated value is the acute criterion divided by 10.

**i** In designated oyster waters, an acute saltwater copper criterion of 5.0 micrograms per liter applies outside of the mixing zone of permitted discharges, and

specified mixing zones for copper will not encompass oyster reefs containing live oysters.

**j** Analytical method for available cyanide should be used.

**k** Criteria are variable depending on pH and temperature. Values conservatively based on a pH of 8.0 and temperature of 30° C. Assumes mussels are present.

**l** State of Colorado hardness-based water quality standards (Colorado Department of Public Health and Environment, 2013. Water Quality Control Commission).

**m** Regulation of Discharge of Pollutants. Canadian Water Quality Guidelines for the protection of Aquatic Life. Part One: guidelines on derivation of

interim health-based values, and S. Carey, 2017. The toxicity of thioturdate to freshwater and marine organisms. III. Generating additional chronic toxicity data for the

refinement of safe environmental exposure concentrations in the US and Europe. *Science of the Total Environment*, 600, 420-428.

• Based on the procedure defined in TCEQ, 2010, *Procedures to implement the Texas Surface Water Quality Standards*. The percentage of dissolved silver that is interfere-free (or dissolved from the dilution correction factor) = dissolved silver concentration (mg/L). The person should use the sum-percentage of the dissolved silver to determine if the water is acceptable for reuse. The acceptable range is 0.6559 ± 0.0044 percent. Available in English, Spanish, and French. DOI: 10.25147/tceq-14-000044-en.pdf. Available online at [www.tceq.texas.gov/tceq/tceqpublications/tceqpublications.aspx?CategoryID=1&CategoryName=Water](http://www.tceq.texas.gov/tceq/tceqpublications/tceqpublications.aspx?CategoryID=1&CategoryName=Water).

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## Surface Water Benchmarks (mg/L) for Organics

Chemical of Concern	CAS No.	Freshwater Acute Benchmark (mg/L)	note	Freshwater Chronic Benchmark (mg/L)	note	Saltwater Acute Benchmark (mg/L)	note	Saltwater Chronic Benchmark (mg/L)	note
<b>Pesticides, PCBs, Other Organics</b>									
aldrin	309-00-2	0.003	a	0.0003	f	0.0013	a	0.00013	f
Atrazine	1912-24-9			0.0018	m				
BHC (alpha)	319-84-6	0.447	c	0.074	c	0.15	c	0.025	c
BHC (beta)	319-85-7	0.498	c	0.083	c				
carbaryl (Sevin)	63-25-2	0.002	a	0.002	a	0.0016	a	0.00016	f
chlordane	12789-03-6 and 57-74-9	0.0024	a	0.000004	a	0.00009	a	0.000004	a
chlorpyrifos (Dursban)	2921-88-2	0.000083	a	0.000041	a	0.000011	a	0.000006	a
<b>4,4'-DDD</b>	72-54-8	0.000189	d	0.000011	d	0.00075	e	0.000025	e
<b>4,4'-DDE</b>	72-55-9	0.0033	e	0.00011	e				
<b>4,4'-DDT</b>	50-29-3	0.0011	a	0.000001	a	0.00013	a	0.000001	a
demeton	8065-48-3			0.0001	a			0.0001	a
diazinon (Spectracide)	333-41-5	0.00017	a	0.00017	a	0.000819	a	0.000819	a
dicofol (Kelthane)	115-32-2	0.0593	a	0.0198	a				
dieldrin	60-57-1	0.00024	a	0.000002	a	0.00071	a	0.000002	a
diuron	330-54-1	0.21	a	0.070	a				
endosulfan I (alpha)	959-98-8	0.00022	a	0.000056	a	0.000034	a	0.000009	a
endosulfan II (beta)	33213-65-9	0.00022	a	0.000056	a	0.000034	a	0.000009	a
endosulfan sulfate	1031-07-8	0.00022	a	0.000056	a	0.000034	a	0.000009	a
endosulfan (all isomers)	115-29-7			0.000051	d				
endrin	72-20-8	0.000086	a	0.000002	a	0.000037	a	0.000002	a
glyphosate	1071-83-6	27	m	0.8	m				
guthion (azinphos-methyl)	86-50-0			0.00001	a			0.00001	a
heptachlor	76-44-8	0.00052	a	0.000004	a	0.000053	a	0.000004	a
heptachlor epoxide	1024-57-3	0.00052	b	0.0000038	b	0.000053	b	0.0000036	b
delta hexachlorocyclohexane (HCH)	319-86-8	0.249	c	0.141	c				
hexachlorocyclohexane (gamma) (Lindane)	58-89-9	0.001126	a	0.00008	a	0.00016	a	0.000016	f
hexachlorocyclopentadiene	77-47-4	0.0021	e	0.0007	e	0.011	e	0.0037	e
malathion	121-75-5			0.00001	a			0.00001	a
methoxychlor	72-43-5			0.00003	a			0.00003	a
mirex (dechlorane)	2385-85-5			0.000001	a			0.000001	a
parathion (ethyl)	56-38-2	0.000065	a	0.000013	a	0.0053	e	0.00178	e
perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.021	p	0.0051	p				
<b>polychlorinated biphenyls (PCBs)</b>	1336-36-3	0.002	a, h	0.000014	a, h	0.01	a, h	0.00003	a, h
toxaphene	8001-35-2	0.00078	a	0.0000002	a	0.00021	a	0.0000002	a
<b>PAHs</b>									
acenaphthene	83-32-9	0.08	i	0.023	i	0.1408	i	0.0404	i
anthracene	120-12-7	0.00194	e	0.0000645	e	0.00108	e	0.000036	e
benz(a)anthracene	56-55-3	0.029	e	0.00097	e				
benzo(a)pyrene	50-32-8	0.00024	d	0.000014	d				
chrysene	218-01-9								
dibenz[a,h]anthracene	53-70-3	0.0003	e	0.00001	e				
fluoranthene	206-44-0	0.0336	j	0.00616	j	0.0161	j	0.00296	j
fluorene	86-73-7	0.064	c	0.011	c	0.3	c	0.05	c
1-methylnaphthalene	90-12-0	0.037	d	0.0021	d				
2-methylnaphthalene	91-57-6	0.38	c	0.063	c	0.18	c	0.03	c
naphthalene	91-20-3	1.480	c	0.25	c	0.75	c	0.125	c
phenanthrene	85-01-8	0.03	a	0.03	a	0.0077	a	0.0046	a
pyrene	129-00-0	0.206	c	0.007	c	0.0074	c	0.00024	c
<b>Munitions and Explosives</b>									
2-amino-4,6-dinitrotoluene (2-ADNT)	35572-78-2	4.440	c	0.74	c	1.5	c	0.5	c
1,3-dinitrobenzene	99-65-0	0.215	o	0.017	o	4.4	n	2.4	n

2,4-dinitrotoluene	121-14-2	7.290	c	1.22	c	13.6	c	8.6	c
HMX (Octogen)	2691-41-0	3.75	o	0.330	o				
1-methyl-3-nitrobenzene (3-nitrotoluene)	99-08-1	2.25	c	0.375	c				
nitrobenzene	98-95-3	3.30	e	1.10	e	4.20	e	1.40	e
nitroglycerin	55-63-0	0.41	c	0.069	c				
2-nitrotoluene	88-72-2	2.64	c	0.44	c				
1-methyl-4-nitrobenzene (4-nitrotoluene)	99-99-0	5.70	c	0.95	c				
PETN (pentaerythritol tetranitrate)	78-11-5	14.7	c	4.9	c	9.6	c	3.2	c
RDX (Cyclonite)	121-82-4	1.39	o	0.186	o	3.08	c	1.03	c
1,3,5-trinitrobenzene	99-35-4	0.06	o	0.011	o	0.61	n	0.35	n
2,4,6-trinitrotoluene (TNT)	118-96-7	0.294	c	0.05	c	0.3	c	0.05	c
<b>Semivolatile Organic Compounds</b>									
benzidine	92-87-5	11.545	c	1.924	c				
benzoic acid	65-85-0	54	c	9	c				
benzyl alcohol	100-51-6	0.15	d	0.0086	d				
biphenyl (diphenyl)	92-52-4			0.014	d				
bis (2-chloroethyl) ether	111-44-4	72	c	12	c				
bis (2-ethyl-hexyl) phthalate	117-81-7	0.06	e	0.02	e	0.3	e	0.10	e
bis (chloroisopropyl) ether	108-60-1	37.847	c	6.308	c				
4-bromophenyl phenyl ether	101-55-3			0.0015	d				
butyl benzyl phthalate	85-68-7	0.56	c	0.093	c	0.883	c	0.147	c
2-chloronaphthalene	91-58-7	0.323	c	0.054	c				
2-chlorophenol	95-57-8	0.78	c	0.13	c	1.59	c	0.265	c
decane	124-18-5	0.88	d	0.049	d				
di-n-butyl phthalate	84-74-2	0.221	c	0.007	c	0.15	c	0.005	c
di-n-octyl phthalate	117-84-0	0.671	c	0.022	c				
dibenzofuran	132-64-9	0.562	c	0.094	c	0.393	c	0.065	c
3,3'-dichlorobenzidine	91-94-1	0.315	c	0.053	c	0.219	c	0.037	c
2,4-dichlorophenol	120-83-2	0.51	c	0.085	c				
diethyl phthalate	84-66-2	6.259	c	1.043	c	2.653	c	0.442	c
dimethyl phthalate	131-11-3	9.90	e	1.65	e	17.40	e	2.90	e
2,4-dimethylphenol	105-67-9	0.63	c	0.105	c				
2,4-dinitrophenol	51-28-5	0.186	c	0.031	c	3.990	c	0.67	c
1,2-diphenylhydrazine	122-66-7	0.069	c	0.012	c				
dodecyl benzenesulfonic acid	27176-87-0					1.754	c	0.058	c
ethylene glycol	107-21-1			192	m				
isophorone	78-59-1	36	c	6	c	3.87	c	0.65	c
3-methyl-4-chlorophenol	59-50-7	0.6	e	0.1	e				
2-methyl-4,6-dinitrophenol (dinitro-o-cresol)	534-52-1	0.069	c	0.012	c				
4-methylphenol (p-cresol)	106-44-5	1.630	c	0.272	c				
2-methylphenol (o-cresol)	95-48-7	3.360	c	0.56	c	3.060	c	0.51	c
n-nitrosodimethylamine	62-75-9	282	c	47	c	990	c	165	c
n-nitrosodiphenylamine	86-30-6	1.740	c	0.29	c	990	c	165	c
nitrosodipropylamine	621-64-7	0.6	c	0.02	c	3.6	c	0.12	c
2-nitrophenol	88-75-5	5.753	c	0.959	c	8.818	c	1.47	c
4-nitrophenol	100-02-7	3.193	c	0.532	c	2.151	c	0.359	c
nonylphenol	25154-52-3	0.028	a	0.0066	a	0.007	a	0.0017	a
2-octanone (methyl hexyl ketone)	111-13-7	0.15	d	0.0083	d				
pentachlorobenzene	608-93-5	0.0084	d	0.00047	d	0.14	e	0.0046	e
pentachlorophenol	87-86-5	0.00319	a, g	0.00245	a, g	0.0151	a	0.0096	a
phenol	108-95-2	3.6	d	0.11	d	16.5	c	2.75	c
propylene glycol	57-55-6			500	m				
1,2,4,5-tetrachlorobenzene	95-94-3	0.096	e	0.0032	e	0.099	e	0.0033	e
2,4,5-trichlorophenol	95-95-4	0.136	a	0.064	a	0.259	a	0.012	a
2,4,6-trichlorophenol	88-06-2	0.081	c	0.0135	c	0.363	c	0.061	c
<b>Volatile Organic Compounds</b>									
acetone	67-64-1	607.4	c	101.2	c	1,692	c	282	c

acrolein (acrylic aldehyde)	107-02-8	0.003	b	0.003	b	0.03	c	0.005	c
acrylonitrile	107-13-1	2.76	e	0.92	e	5.42	e	1.81	e
benzene	71-43-2	2.3	d	0.13	d	3.27	e	1.09	e
bromodichloromethane	75-27-4	12.962	c	2.16	c				
2-butanone (MEK)	78-93-3	254.42	c	42.4	c				
n-butylbenzene	104-51-8	0.213	c	0.036	c				
carbon disulfide	75-15-0	0.7	c	0.105	c				
carbon tetrachloride (tetrachloromethane)	56-23-5	0.18	d	0.0098	d	15.00	e	5.00	e
chlorobenzene	108-90-7	1.1	d	0.064	d	3.00	e	1.00	e
chlorodibromomethane (dibromochloromethane)	124-48-1	0.771	c	0.129	c				
chloroform	67-66-3	5.37	e	1.79	e	8.40	e	2.8	e
chloromethane	74-87-3	165	c	28	c	81	c	13.5	c
cumene (isopropylbenzene)	98-82-8	1.530	c	0.255	c				
cymene (4-isopropyltoluene)	99-87-6	0.254	c	0.042	c				
1,2-dichlorobenzene	95-50-1	0.66	c	0.11	c	0.591	c	0.099	c
1,3-dichlorobenzene	541-73-1	0.153	c	0.085	c	0.855	c	0.142	c
1,4-dichlorobenzene	106-46-7	0.66	c	0.11	c	0.597	c	0.099	c
dichlorodifluoromethane (Freon-12)	75-71-8	11.78	c	1.963	c				
1,1-dichloroethane	75-34-3	0.6	e	0.21	e				
1,2-dichloroethane	107-06-2	37.68	e	12.56	e	34.5	e	11.50	e
1,1-dichloroethene	75-35-4	9.08	e	3.03	e	75.0	e	25.00	e
1,2-dichloroethene, <i>trans</i>	156-60-5	66.00	e	22.00	e				
1,2-dichloroethene (mixed <i>cis</i> and <i>trans</i> isomers)	540-59-0	42.00	e	14.00	e	3.4	e	1.12	e
1,2-dichloropropane	78-87-5	17.96	e	5.99	e	18.3	e	6.1	e
1,3-dichloropropene	542-75-6	1.23	c	0.205	c	0.237	c	0.04	c
ethyl benzene	100-41-4	3.00	e	1.00	e	1.56	e	0.52	e
hexachlorobutadiene	87-68-3	0.1310	e	0.00436	e	0.0096	e	0.00032	e
hexachloroethane	67-72-1	0.21	d	0.012	d	0.30	e	0.099	e
hexane, <i>n</i> -	110-54-3	0.01	d	0.00058	d				
2-hexanone (methyl butyl ketone; MBK)	591-78-6	36.79	c	6.13	c				
4-methyl-2-pentanone (MIBK)	108-10-1	158.10	c	26.40	c	369.0	c	61.50	c
methyl bromide (bromomethane)	74-83-9	0.66	c	0.11	c	3.6	c	0.60	c
methyl methacrylate	80-62-6	69.72	c	11.62	c				
methyl <i>tert</i> -butyl ether (MTBE)	1634-04-4	151	k	51	k	53.0	k	18	k
methylene chloride	75-09-2	66.00	e	22.00	e	32.55	e	10.85	e
1-pentanol	71-41-0	2.00	d	0.11	d				
2-propanol	67-63-0	0.13	d	0.0075	d				
n-propylbenzene	103-65-1	0.385	c	0.064	c				
sec-butylbenzene	135-98-8	0.246	c	0.041	c				
tert-butylbenzene	98-06-6	0.289	c	0.048	c				
styrene (vinyl benzene)	100-42-5	7.515	c	1.25	c	2.73	c	0.455	c
1,1,2,2-tetrachloroethane	79-34-5	2.79	c	0.465	c	2.706	c	0.451	c
tetrachloroethene	127-18-4	3.84	e	1.28	e	1.50	e	0.50	e
toluene	108-88-3	10.21	e	3.40	e	3.90	e	1.30	e
tribromomethane (bromoform)	75-25-2	0.897	c	0.149	c	7.32	c	1.22	c
1,2,3-trichlorobenzene	87-61-6			0.0080	m				
1,2,4-trichlorobenzene	120-82-1	0.309	c	0.0515	c	0.135	c	0.0225	c
1,1,1-trichloroethane	71-55-6	14.72	e	4.91	e	21.3	e	7.10	e
1,1,2-trichloroethane	79-00-5	5.40	c	0.90	c	1.650	c	0.275	c
trichloroethene	79-01-6	9.00	e	3.00	e	4.80	e	1.60	e
1,1,2-trichlorotrifluoroethane (Freon-113)	76-13-1	1.239	c	0.207	c				
trichlorofluoromethane (Freon-11)	75-69-4	5.225	c	0.871	c				
1,2,4-trimethylbenzene (Pseudocumene)	95-63-6	0.462	c	0.077	c	1.305	c	0.217	c
1,3,5-trimethylbenzene (Mesitylene)	108-67-8	0.4245	c	0.071	c				
vinyl acetate	108-05-4	0.28	d	0.016	d				
vinyl chloride	75-01-4	16.90	c	2.82	c				
<i>m</i> -xylene	108-38-3	0.032	d	0.0018	d				
xylenes	1330-20-7	4.02	e	1.34	e	2.55	e	0.85	e

This table contains surface water benchmarks for organic compounds.

**COCs listed in bold and italics are considered bioaccumulative.**

- a Criteria are from Texas Surface Water Quality Standards (30 TAC 307.6, Table 1). Effective March 1, 2018.
- b National Ambient Water Quality Criteria. Verified January 2018.
- c Benchmark derived by TCEQ using the LC<sub>50</sub> approach in accordance with the Texas Surface Water Quality Standards 30 TAC 307.6 (c) (7) before 2016.
- d Benchmark from Suter, G.W. II, and C.L. 1990. *Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota*. Revised. Oak Ridge, TN: Lockheed Martin Energy Systems, U.S. Department of Energy, EC/ED/TM-06/R2.
- e Benchmark derived by TCEQ using the LC<sub>50</sub> approach in accordance with the Texas Surface Water Quality Standards 30 TAC 307.6(c)(7).
- f There is only an acute criterion (no chronic criterion). The indicated value is the acute criterion divided by 10.
- g Value calculated using pH of 6. See formula on the next sheet and discussion in 3.2.3 of TRRP-24 for guidance on the appropriate pH value to use.
- h Criteria apply to the sum of the congeners, isomers, homologs, or Aroclor analysis.
- i Surface water value calculated by the EPA for use in the derivation of the sediment quality criteria. U.S. EPA. 1993. *Sediment quality criteria for the protection of benthic surface waters* (and EPA's role in the derivation of the sediment quality criteria). U.S. EPA. 1993. *Sediment quality criteria for the protection of benthic marine life*, R.R., A. Steen, P.A. Radomski, D.R. Webb, W.K. Attolia, F.E. Gostomski, T. Davies, J.K. Pockell, W.A. Stubbendieck, K.K. Troutier, T.A. Springer, and R. Ettinger. 2002. MDEQ's ambient water quality standards given more protection. MDEQ's generally applicable rule is below its solubility limit. C.A. Staples, et al. 2011. Assessing the chronic risk of organic pollutants to fish and shellfish. Canadian Journal of Fisheries and Aquatic Sciences available online at sheets available on derivation of
- j Nipper, M., R.S. Carr, J.M. Bremnerdien, K.L. Hooten, K. Miller, and S. Saepora. 2001. Development of marine toxicity data for organotin compounds. *Arch. Environ. Contam. Toxicol.*
- k Vanlige, S.S., D.M. Oakes, C.J. Maxwell, C.J.C. Weish, F.M. Creteau, P.H. Keno, and F.B. Daniel. 1999. Nitroaromatic munition compounds: environmental effects and screening procedures. *J. Environ. Sci. Res.* 37:21-32. J. Newsted. 2010. Aquatic toxicology of perfluorinated chemicals. *Rev. Env. Contam. Toxicol.* 202:1-52. A freshwater risk based exposure level of 1 TEU mg/L was developed by the author that is protective of predatory birds (bald eagle, herring gull and belted kingfisher).

End of Worksheet

## Hardness or pH Dependent Formulas

Chemical of Concern	note	Freshwater Acute	Freshwater Chronic
cadmium	d	$(1.136672 - [\ln(\text{hardness})] (0.041838)) * (\text{we}^{(1.0166 [\ln(\text{hardness})] - 2.4743)})$	$(1.101672 - [\ln(\text{hardness})] (0.041838)) * (\text{we}^{(0.7409 [\ln(\text{hardness})] - 4.719)})$
chromium (tri)	d	$0.316 \text{ we}^{(0.8190 [\ln(\text{hardness})] + 3.7256)}$	$0.860 \text{ we}^{(0.8190 [\ln(\text{hardness})] + 0.6848)}$
copper	d	$0.960 \text{ me}^{(0.9422 [\ln(\text{hardness})] - 1.6448)}$	$0.960 \text{ me}^{(0.8545 [\ln(\text{hardness})] - 1.6463)}$
lead	d	$(1.46203 - [\ln(\text{hardness})] (0.145712)) * (\text{we}^{(1.273 [\ln(\text{hardness})] - 1.460)})$	$(1.46203 - [\ln(\text{hardness})] (0.145712)) * (\text{we}^{(1.273 [\ln(\text{hardness})] - 4.705)})$
manganese	d	$e^{(0.3331 [\ln(\text{hardness})] + 6.4676)}$	$e^{(0.3331 [\ln(\text{hardness})] + 5.8743)}$
nickel	d	$0.998 \text{ we}^{(0.8460 [\ln(\text{hardness})] + 2.255)}$	$0.997 \text{ we}^{(0.8460 [\ln(\text{hardness})] + 0.0584)}$
uranium	d	$e^{(1.1021 [\ln(\text{hardness})] + 2.7088)}$	$e^{(1.1021 [\ln(\text{hardness})] + 2.2382)}$
silver	d	$0.85 e^{(1.72 [\ln(\text{hardness})] - 6.59)}$	No formula available for chronic
zinc	d	$0.978 \text{ we}^{(0.8473 [\ln(\text{hardness})] + 0.884)}$	$0.986 \text{ we}^{(0.8473 [\ln(\text{hardness})] + 0.884)}$
pentachlorophenol		$e^{(1.005(\text{pH}) - 4.869)}$	$e^{(1.005(\text{pH}) - 5.134)}$

This worksheet contains formulas used to modify surface water benchmarks for cadmium, chromium, copper, lead, manganese, nickel, uranium, silver, zinc, and pentachlorophenol.

- (d) Indicates that the benchmarks are for the dissolved portion in water.
- (w) A Water Effects Ratio (WER) is applicable to certain criteria for metals. The criterion is multiplied by a WER in order to incorporate the effects of local water chemistry on toxicity. The
- (m) Indicates that a criterion may be multiplied by a WER or based on a biotic ligand model result in order to incorporate effects of local water chemistry on toxicity. The WER multiplier is  
 $e$  The mathematical constant that is the basis of the natural logarithm. When rounded to four values past the decimal,  $e$  is equal to 2.7183.

Note that resulting values using these formulas will be in  $\mu\text{g/L}$ .

Equations for manganese and uranium from the State of Colorado hardness-based water quality standard. Colorado Department of Public Health and Environment, Water Quality Control  
The acute equation for silver is from the National Ambient Water Quality Criteria (U.S. EPA, 2013).

End of worksheet.

## Sediment Benchmarks, Second-Effects Levels, and Benthic PCLs (mg/kg dry weight)

Chemical of Concern	note	CAS No.	Freshwater Benchmark	note	Freshwater Second Effects Level	note	Freshwater Benthic PCL	Saltwater Benchmark	note	Saltwater Second-Effects Level	note	Saltwater Benthic PCL
<b>Metals, Inorganics</b>												
antimony		7440-36-0	0.3	p	12.0	p	6.15	2	c	25	c	13.5
arsenic		7440-38-2	9.79	a	33.0	a	21.395	8.2	b	70	b	39.1
<b>cadmium</b>		7440-43-9	0.99	a	4.98	a	2.985	1.2	b	9.6	b	5.4
chromium		7440-47-3	43.4	a	111	a	77.2	81	b	370	b	225.5
cobalt		7440-48-4	50	d								
<b>copper</b>		7440-50-8	31.6	a	149	a	90.3	34	b	270	b	152
iron		7439-89-6	20,000	d	40,000	d	30,000					
lead		7439-92-1	35.8	a	128	a	81.9	46.7	b	218	b	132.35
manganese		7439-96-5	460	d	1,100	d	780					
<b>mercury</b>		7439-97-6	0.18	a	1.06	a	0.62	0.15	b	0.71	b	0.43
<b>nickel</b>		7440-02-0	22.7	a	48.6	a	35.65	20.9	b	51.6	b	36.25
silver		7440-22-4	0.57	n	1.7	n	1.14	1.0	b	3.7	b	2.35
<b>zinc</b>		7440-66-6	121	a	459	a	290	150	b	410	b	280
<b>PAHs</b>												
acenaphthene		83-32-9	0.00671	e	0.0889	e	0.05	0.016	b	0.500	b	0.26
acenaphthylene		208-96-8	0.00587	e	0.128	e	0.07	0.044	b	0.640	b	0.34
anthracene		120-12-7	0.0572	a	0.845	a	0.45	0.0853	b	1.1	b	0.59
benz[a]anthracene		56-55-3	0.108	a	1.050	a	0.58	0.261	b	1.6	b	0.93
benzo[a]pyrene		50-32-8	0.150	a	1.450	a	0.80	0.43	b	1.6	b	1.015
chrysene		218-01-9	0.166	a	1.290	a	0.73	0.384	b	2.8	b	1.59
dibenz[a,h]anthracene		53-70-3	0.033	a	0.135	e	0.08	0.0634	b	0.26	b	0.16
fluoranthene		206-44-0	0.423	a	2.230	a	1.33	0.6	b	5.1	b	2.85
fluorene		86-73-7	0.0774	a	0.536	a	0.31	0.019	b	0.540	b	0.28
2-methyl naphthalene		91-57-6	0.0202	e	0.201	e	0.11	0.07	b	0.670	b	0.37
naphthalene		91-20-3	0.176	a	0.561	a	0.37	0.16	b	2.1	b	1.13
phenanthrene		85-01-8	0.204	a	1.170	a	0.69	0.24	b	1.5	b	0.87
pyrene		129-00-0	0.195	a	1.520	a	0.86	0.665	b	2.6	b	1.63
low-molecular-weight PAHs	g, h							0.552	b	3.16	b	1.86
high-molecular-weight PAHs	g, i							1.7	b	9.6	b	5.65
total PAHs	g, j		1.610	a	22.800	a	12.205	4.022	b	44.792	b	24.41
<b>Munitions and Explosives</b>												
2-amino-4,6-dinitrotoluene (2-ADNT)		35572-78-2	4.60	o	27.58	o	16.09	3.11	o	9.32	o	6.2
1,3-dinitrobenzene		99-65-0	0.02	o	0.19	o	0.10	2.13	o	3.90	o	3.0
2,4-dinitrotoluene		121-14-2	1.34	o	8.02	o	4.68	9.46	o	14.96	o	12.2
HMX (Octogen)		2691-41-0	0.19	o	2.20	o	1.20					
1-methyl-3-nitrobenzene (3-nitrotoluene)		99-08-1	0.75	o	4.49	o	2.62					
nitrobenzene		98-95-3	2.10	o	6.29	o	4.20	2.67	o	8.00	o	5.3
nitroglycerin		55-63-0	0.10	o	0.62	o	0.36					
2-nitrotoluene		88-72-2	0.88	o	5.26	o	3.07					
4-nitrotoluene (1-methyl, 4-nitro-benzene)		99-99-0	1.89	o	11.36	o	6.63					
PETN (Pentaerythrite-tetranitrate)		78-11-5	310.94	o	932.81	o	621.87	203.06	o	609.18	o	406.1
RDX (Cyclonite)		121-82-4	0.23	o	1.69	o	0.96	1.25	o	3.75	o	2.5
1,3,5-trinitrobenzene		99-35-4	0.01	o	0.04	o	0.03	0.25	o	0.44	o	0.3
2,4,6-trinitrotoluene (TNT)		118-96-7	0.18	o	1.06	o	0.62	0.18	o	1.08	o	0.6
<b>Pesticides, PCBs, and Other Organics</b>												
<b>aldrin</b>		309-00-2	0.002	d	0.08	d	0.04					
<b>alpha-BHC</b>		319-84-6	0.006	d	0.1	d, m	0.05					
<b>Aroclor 1016</b>		12674-11-2	0.007	d	0.53	d, m	0.27					



<b>Aroclor 1248</b>	12672-29-6	0.03	d	1.5	d, m	0.77					
<b>Aroclor 1254</b>	27323-18-8	0.06	d	0.34	d, m	0.20	0.0633	e	0.709	e	
<b>Aroclor 1260</b>	11096-82-5	0.005	d	0.24	d, m	0.12					
benzoic acid	65-85-0	2.9	n	3.8	n	3.35	0.65	n	0.65	n	
benzyl alcohol	100-51-6						0.057	n	0.073	n	
<b>BHC</b>	g	608-73-1	0.003	d	0.12	d, m	0.06				
<b>beta-BHC</b>		319-85-7	0.005	d	0.21	d, m	0.11				
<b>delta-BHC</b>		319-86-8	0.13	l	2.3	l	1.22				
<b>gamma-BHC (Lindane)</b>		58-89-9	0.00237	a	0.00499	a	0.004	0.00032	e	0.00099	e
bis(2-ethylhexyl)phthalate		117-81-7	0.5	n	22.0	n	11.3	0.182	f	2.647	f
di-n-butyl phthalate		84-74-2	11	l	80.0	l	45.5	2.2	n, m	17	n, m
di-n-octyl phthalate		117-84-0	0.039	n	1.1	n	0.6	0.58	n, m	45	n m
butyl benzyl phthalate		85-68-7	11	l	150.0	l	81	0.049	n, m	0.64	n, m
diethyl phthalate		84-66-2	0.63	l	11.0	l	5.8	0.61	n, m	1.10	n, m
dimethyl phthalate		131-11-3	1.49	o	8.9	o	5.22	0.53	n, m	0.53	n, m
biphenyl		92-52-4	1.1	l	8.5	l	4.80				
<b>chlordane (Total)</b>		57-74-9	0.00324	a	0.0176	a	0.01	0.00226	e	0.00479	e
Diazinon/Spectracide		331-41-5	0.00190	l	0.0073	l	0.005				
<b>dieldrin</b>		60-57-1	0.00190	a	0.0618	a	0.03	0.00071	e	0.00430	e
2,4-dimethylphenol		105-67-9						0.029	n	0.029	n
dibenzofuran		132-64-9	0.2	n	0.68	n	0.44	0.15	n, m	0.580	n, m
endosulfan, alpha-		959-98-8	0.0029	l	0.0074	l	0.005				
endosulfan, beta-		33213-65-9	0.014	l	0.035	l	0.025				
<b>endrin</b>		72-20-8	0.00222	a	0.207	a	0.10	0.00267	e	0.06240	e
<b>HCB (Hexachlorobenzene)</b>		118-74-1	0.02	d	0.24	d, m	0.13				
<b>heptachlor</b>		76-44-8	0.0006	e	0.00274	e	0.002	0.0006	e	0.00274	e
<b>heptachlor epoxide</b>		1024-57-3	0.00247	a	0.016	a	0.01				
hexachlorocyclopentadiene		77-47-4	0.067	o	0.202	o	0.135	0.36	o	1.06000	o
Malathion		121-75-5	0.00067	l	0.0062	l	0.003				
Methoxychlor		72-43-5	0.019	l	0.095	l	0.057				
<b>Mirex</b>		2385-85-5	0.007	d	1.3	d, m	0.65				
nonylphenol		25154-52-3	1.4	e				1	e		
2-methylphenol (o-cresol)		95-48-7						0.063	n	0.063	n
4-methylphenol (p-cresol)		106-44-5	0.26	n	2	n	1.13	0.67	n	0.67	n
3-methyl-4-chlorophenol		59-50-7	0.94	o	5.62	o	3.28				
parathion (ethyl)		56-38-2	0.00074	o	0.0037	o	0.002	0.1	o	0.30	o
pentchlorobenzene		608-93-5	0.15	o	2.66	o	1.405	1.46	o	44.35	o
<b>pentachlorophenol</b>		87-86-5	1.2	n	1.2	n	1.2	0.36	n	0.69	n
perfluorooctanesulfonic acid (PFOS)		1763-23-1	0.114	o	0.47	o	0.29				
phenol		108-95-2	0.12	n	0.21	n	0.17	0.42	n	1.20	n
1,2,4,5-tetrachlorobenzene		95-94-3	0.053	o	1.59	o	0.82	0.055	o	1.64	o
<b>sum DDD</b>	g	72-54-8	0.00488	a	0.0280	a	0.02	0.00122	e	0.00781	e
<b>sum DDE</b>	g	72-55-9	0.00316	a	0.0313	a	0.02	0.00207	e	0.374	e
<b>sum DDT</b>	g	50-29-3	0.00416	a	0.0629	a	0.03	0.00119	e	0.00477	e
<b>total DDTs</b>	g		0.00528	a	0.572	a	0.29	0.00389	f	0.0517	f
<b>total PCBs</b>	g	1336-36-3	0.0598	a	0.676	a	0.37	0.0227	b	0.180	b
<b>Toxaphene</b>		8001-35-2	0.0001	k, m	0.032	k, m	0.02				
Volatile Organic Compounds											
acetone		67-64-1	60.03	o	360.18	o	210.11	167.23	o	1003.36	o
acrylonitrile		107-13-1	0.55	o	1.65	o	1.10	1.08	o	3.24	o
benzene		71-43-2	0.16	o	2.87	o	1.52	1.36	o	4.08	o
n-butylbenzene		104-51-8	1.09	o	6.57	o	3.83				
n-propylbenzene		103-65-1	0.72	o	4.35	o	2.54				
sec-butylbenzene		135-98-8	0.88	o	5.28	o	3.08				
tert-butylbenzene		98-06-6	1.21	o	7.26	o	4.24				



bromodichloromethane	75-27-4	2.46	o	14.74	o	8.60			
2-butanone	78-93-3	25.71	o	154.26	o	89.99			
carbon disulfide	75-15-0	0.12	o	0.78	o	0.45			
carbon tetrachloride	56-23-5	1.2	l	21	l	11.10	12.25	o	36.74 o
chlorobenzene	108-90-7	0.74	o	3.0	o	1.87	2.73	o	8.18 o
chlorodibromomethane	124-48-1	0.16	o	0.94	o	0.55			
chloroform (trichloromethane)	67-66-3	1.889	o	5.67	o	3.78	2.95	o	8.86 o
chloromethane	74-87-3	17.8	o	106.8	o	62.30	8.74	o	52.43 o
cumene (isopropylbenzene)	98-82-8	8.99	o	53.95	o	31.47			
p-cymene (4-isopropyltoluene)	99-87-6	1	o	5.98	o	3.49			
1,2-dichlorobenzene	95-50-1	0.83	o	4.95	o	2.89	0.74	o	4.44 o
1,3-dichlorobenzene	541-73-1	0.19	o	0.35	o	0.27	0.32	o	1.95 o
1,4-dichlorobenzene	106-46-7	0.77	o	4.65	o	2.71	0.7	o	4.21 o
dichlorodifluoromethane	75-71-8	3.68	o	22.09	o	12.89			
1,1-dichloroethane	75-34-3	2.32	o	13.89	o	8.11			
1,2-dichloroethane	107-06-2	9.56	o	28.68	o	19.12	8.75	o	26.26 o
1,1-dichloroethene	75-35-4	3.74	o	11.20	o	7.47	30.82	o	92.47 o
1,2-dichloroethene ( <i>trans</i> )	156-60-5	23.95	o	71.84	o	47.90			
1,2-dichloroethene (mixed <i>cis</i> and <i>trans</i> )	540-59-0	12.28	o	36.85	o	24.57	0.98	o	2.95 o
1,2-dichloropropane	78-87-5	7.05	o	21.12	o	14.09	7.17	o	21.52 o
1,3-dichloropropene	542-75-6	0.23	o	1.37	o	0.80	0.04	o	0.26 o
ethylbenzene	100-41-4	2.63	o	7.88	o	5.26	1.37	o	4.1 o
HCBD (hexachlorobutadiene)	87-68-3	0.055	k, m	0.55	k, m	0.30	0.022	o	0.67 o
hexachloroethane	67-72-1	0.225	o	3.945	o	2.1	1.86	o	5.64 o
n-hexane	110-54-3	0.0031	o	0.05	o	0.027			
2-hexanone	591-78-6	4.7	o	28.2	o	16.45			
4-methyl-2-pentanone (MIBK)	108-10-1	19.43	o	116.59	o	68.01	45.34	o	272.06 o
methyl bromide	74-83-9	0.08	o	0.46	o	0.27	0.42	o	2.49 o
methyl methacrylate	80-62-6	9.5	o	56.98	o	33.24			
methylene chloride	75-09-2	15.51	o	46.52	o	31.02	7.65	o	22.94 o
1-pentanol	71-41-0	0.07	o	1.63	o	0.85			
2-propanol	67-63-0	0.0047	o	0.08	o	0.042			
styrene	100-42-5	10.24	o	61.42	o	35.83	3.72	o	22.31 o
1,1,2,2-tetrachloroethane	79-34-5	0.63	o	3.80	o	2.22	0.61	o	3.69 o
tetrachloroethene	127-18-4	2.74	o	8.21	o	5.48	1.07	o	3.21 o
toluene	108-88-3	6.76	o	20.29	o	13.53	2.58	o	7.75 o
tribromomethane (bromoform)	75-25-2	0.22	o	1.31	o	0.77	1.78	o	10.67 o
1,2,4-trichlorobenzene	120-82-1	0.88	o	5.31	o	3.10	0.39	o	2.32 o
1,1,1-trichloroethane	71-55-6	8.27	o	24.79	o	16.53	11.95	o	35.86 o
1,1,2-trichloroethane	79-00-5	0.98	o	5.88	o	3.43	0.3	o	1.8 o
trichloroethene	79-01-6	4.56	o	13.69	o	9.13	2.43	o	7.3 o
trichlorofluoromethane	75-69-4	1.69	o	10.12	o	5.91			
1,1,2-trichlorotrifluoroethane	76-13-1	2.78	o	16.7	o	9.74			
1,2,4-trimethylbenzene	95-63-6	0.76	o	4.58	o	2.67	2.16	o	12.95 o
1,3,5-trimethylbenzene	108-67-8	0.77	o	4.59	o	2.68			
vinyl acetate	108-05-4	0.01	o	0.179	o	0.09			
vinyl chloride	75-01-4	1.96	o	11.78	o	6.87			
m-xylene	108-38-3	0.0046	o	0.081	o	0.04			
xlenes	1330-20-7	4	o	12.01	o	8.01	2.54	o	7.62 o

This table contains sediment benchmarks for inorganic and organic compounds.

*COCs listed in bold and italics are considered bioaccumulative.*

**COCs listed in bold and italics are considered bioaccumulative.**  
<sup>a</sup> Macdonald, D.D., C.G. Ingerson, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Environ. Contam. Toxicol.* 39: 20-31.  
 Brinkley, R.K., E.S. Brinkley, M.R. Peth, R.S. Lohman, F. Antunes, D. Croteau, T. Hwang, J. Hwang, and D. G. Giesy. 1998. Adverse biological effects with increasing toxic concentrations in marine and estuarine sediments. *Environmental Monitoring and Assessment* 87: 1-12.  
 Myles, C.R. and L.C. McMurtry. 1999. Human health risk assessment of sediment effects for the Great Lakes National Status and Trends Program. Technical memo. Seattle, National Oceanic and Atmospheric Administration, Seattle, Washington, May 1999.  
 Ontario Ministry of the Environment, Water Resources Branch. Lowest effect level used as benchmark, and severe-effect level used as second effects level.



e Canadian sediment Quality Guidelines for the protection of aquatic life. These sediment quality guidelines are used as benchmark, provide effects levels used as secondary effects levels, [see page 17](#) of this report, e.g., 90% bioavailability levels from C.L. Gauthier, 1990. The development and implementation of Canadian sediment Quality Guidelines. Development and progress in sediment Quality guidelines for protection of aquatic life and their use in risk assessment. A series of papers published by the Canadian Council of Ministers of the Environment (CCME) and the International Association for Great Lakes Research (IAGLR) comparing the Canadian sediment quality guidelines with those of the U.S. EPA and the International Organization for Standardization (ISO). The new Canadian sediment quality guidelines are based on the results of the Canadian sediment quality survey. This survey was conducted by the Canadian Environmental Protection Agency (EPA) and the Canadian Council of Ministers of the Environment (CCME), and involved the participation of various government agencies and industry. The survey was designed to provide information on the quality of sediments in Canadian waters, including lakes, rivers, and coastal areas. The survey results were used to develop the Canadian sediment quality guidelines, which are intended to protect the environment and public health. The Canadian sediment quality guidelines are based on the results of the Canadian sediment quality survey. This survey was conducted by the Canadian Environmental Protection Agency (EPA) and the Canadian Council of Ministers of the Environment (CCME), and involved the participation of various government agencies and industry. The survey was designed to provide information on the quality of sediments in Canadian waters, including lakes, rivers, and coastal areas. The survey results were used to develop the Canadian sediment quality guidelines, which are intended to protect the environment and public health.

End of Worksheet



## Soil Benchmarks (mg/kg dry weight)

Chemical of Concern	note	CAS No.	Soil Invertebrates	note	Plants	note	Median Background	note
<b>Metals, Inorganics</b>								
aluminum	d	7429-90-5					30,000	a
antimony		7440-36-0	78	g	5	f	1	a
arsenic		7440-38-2	60	e	18	n	5.9	a
barium		7440-39-3	330	i	500	f	300	a
beryllium		7440-41-7	40	j	10	f	1.5	a
boron		7440-42-8			0.5	f	30	a
bromine		7726-95-6			10	f		
<i>cadmium</i>		7440-43-9	140	k	32	k	1	b, c
<i>chromium</i>		7440-47-3	0.4	e	1	f	30	a
cobalt		7440-48-4			13	l	7	a
<i>copper</i>		7440-50-8	80	h	70	h	15	a
fluorine (soluble fluoride)		7782-41-4			200	f	190	a
iodine		7553-56-2			4	f		
iron	m	7439-89-6					15,000	a
<i>lead</i>		7439-92-1	1700	o	120	o	15	a
lithium		7439-93-2			2	f	20	b, c
manganese		7439-96-5	450	q	220	q	300	a
<i>mercury</i>		7439-97-6	0.1	e	0.3	f	0.04	a
molybdenum		7439-98-7			2	f	1	b, c
<i>nickel</i>		7440-02-0	280	r	38	r	10	a
<i>selenium</i>		7782-49-2	4.1	s	0.52	s	0.3	a
<i>silver</i>		7440-22-4			560	t	1	b, c
strontium		7440-24-6					100	a
technetium		7440-26-8			0.2	f		
thallium		7440-28-0			1	f		
thorium		7440-29-1					9.3	a
tin		7440-31-5			50	f	0.9	a
titanium		7440-32-6					2,000	a
uranium		7440-61-1			5	f	50	b, c
vanadium		7440-62-2			2	f	50	a
<i>zinc</i>		7440-66-6	120	u	160	u	30	a
PAHs								

total PAHs		2.8	v	2.8	v	
<b>Munitions and Explosives</b>						
1,3,5-trinitrobenzene	99-35-4	18	w	9	w	
2,4,6-trinitrotoluene (TNT)	118-96-7	15	w	8	w	
2,4-dinitrotoluene	121-14-2	18	w	6	w	
2,6-dinitrotoluene	606-20-2	7	w	5	w	
2-amino-4,6-dinitrotoluene (2-ADNT)	35572-78-2	43	w	14	w	
4-amino-2,6-dinitrotoluene (4-ADNT)	1946-51-0	18	w	33	w	
HMX	2691-41-0	16	w			
nitrobenzene	98-95-3	40	e			
RDX (Cyclonite)	121-82-4	72	w	71	w	
nitroglycerin	55-63-0	13	w	21	w	
<b>Semivolatile Organic Compounds</b>						
biphenyl (diphenyl)	92-52-4			60	f	
3-chlorophenol	108-43-0	10	e	7	f	
3,4-dichlorophenol	95-77-2	20	e	20	f	
di-n-butyl phthalate	84-74-2			200	f	
diethyl phthalate	84-66-2			100	f	
dimethylphthalate	131-11-3	200	e			
2,4-dinitrophenol	51-28-5			20	f	
4-nitrophenol	100-02-7	7	e			
n-nitrosodiphenylamine	86-30-6	20	e			
pentachloroaniline	527-20-8	100	e			
pentachlorobenzene	608-93-5	20	e			
<b>pentachlorophenol</b>	87-86-5	31	p	5	p	
phenol	108-95-2	30	e	70	f	
1,2,3,4-tetrachlorobenzene	634-66-2	10	e			
2,3,4,5-tetrachlorophenol	4901-51-3	20	e			
2,4,5-trichlorophenol	95-95-4	9	e	4	f	
2,4,6-trichlorophenol	88-06-2	10	e			
<b>Volatile Organic Compounds</b>						
chlorobenzene	108-90-7	40	e			
1,4-dichlorobenzene	106-46-7	20	e			
1,2-dichloropropane	78-87-5	700	e			
styrene	100-42-5			300	f	
toluene	108-88-3			200	f	

1,2,3-trichlorobenzene	87-61-6	20	e		
1,2,4-trichlorobenzene	120-82-1	20	e		
<b>Pesticides, PCBs, and Other Organics</b>					
<b><i>polychlorinated biphenyls (PCBs)</i></b>	1336-36-3		40	f	
3-chloroaniline	108-42-9	30	e	20	f
2,4-dichloroaniline	554-00-7	100	e		
3,4-dichloroaniline	95-76-1	20	e		
hexachlorocyclopentadiene	77-47-4		10	f	
2,4,5-trichloroaniline	636-30-6	20	e	20	f
2,3,5,6-tetrachloroaniline	3481-20-7	20	e	20	f
chloroacetamide	79-07-2	2	e		
<b><i>furan</i></b>	110-00-9		600	f	

This table contains soil benchmarks for inorganic and organic compounds.

***COCs listed in bold and italics are considered bioaccumulative.***

- a Texas-specific median background concentrations. 30 TAC 350.51(m).
- b U.S. Geological Survey Open-File Report 2004-1001. The dataset for each metal comprised 974 soil data points from samples collected
- c The values for cadmium, molybdenum, silver, and uranium are the assigned proxy values, because for each metal more than 50 percent of
- d Potential ecological risks associated with aluminum in soils are based on the measured soil pH. Where aluminum is a COC, it should only
- e Efroymson, R.A., M.E. Will, and G.W. Suter II. 1997. *Toxicological benchmarks for contaminants of potential concern for effects on soil and*
- f Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997. *Toxicological benchmarks for screening contaminants of potential concern*
- g U.S. EPA. 2005. Ecological soil screening levels for antimony. Interim final. OSWER directive 9285.7-61. Washington.
- h U.S. EPA. 2007. Ecological soil screening levels for copper. Interim final. OSWER directive 9285.7-68. Washington.
- i U.S. EPA. 2005. Ecological soil screening levels for barium. Interim final. OSWER directive 9285.7-63. Washington.
- j U.S. EPA. 2005. Ecological soil screening levels for beryllium. Interim final. OSWER directive 9285.7-64. Washington.
- k U.S. EPA. 2005. Ecological soil screening levels for cadmium. Interim final. OSWER directive 9285.7-65. Washington.
- l U.S. EPA. 2005. Ecological soil screening levels for cobalt. Interim final. OSWER directive 9285.7-67. Washington.
- m Iron is not expected to be toxic to plants in well-aerated soils between pH 5 and 8. Importance is based less on its direct chemical toxicity
- n U.S. EPA. 2005. *Ecological soil screening levels for arsenic.* Interim final. OSWER directive 9285.7-62. Washington.
- o U.S. EPA. 2005. *Ecological soil screening levels for lead.* Interim final. OSWER directive 9285.7-70. Washington.
- p U.S. EPA. 2007. *Ecological soil screening levels for pentachlorophenol.* Interim final. OSWER directive 9285.7-58. Washington.
- q U.S. EPA. 2007. *Ecological soil screening levels for manganese.* Interim final. OSWER directive 9285.7-71. Washington.
- r U.S. EPA. 2007. *Ecological soil screening levels for nickel.* Interim final. OSWER directive 9285.7-76. Washington.
- s U.S. EPA. 2007. *Ecological soil screening levels for selenium.* Interim final. OSWER directive 9285.7-72. Washington.
- t U.S. EPA. 2006. *Ecological soil screening levels for silver.* Interim final. OSWER directive 9285.7-77. Washington.
- u U.S. EPA. 2007. *Ecological soil screening levels for zinc.* Interim final. OSWER directive 9285.7-73. Washington.
- v The TCEQ has replaced all soil PAH benchmarks with the lowest Conservative PCL for total PAHs (2.8 mg/kg) for wildlife from the
- w Checkai, R., and R. Kuperman. 2011. Soil invertebrate and plant eco-SSLs for energetic materials: Methodology and resulting values.

End of worksheet

## **iota Concentration Guides (BCGs) (pCi/L or pCi/g)**

Radionuclide	Aquatic		Terrestrial	
	Water (pCi/L)	Sediment (pCi/g)	Water (pCi/L)	Soil (pCi/g)
antimony-125	4.E+05	7.E+03	7.E+06	3.E+03
americium-241	4.E+02	5.E+03	2.E+05	4.E+03
cerium-144	2.E+03	3.E+03	3.E+06	1.E+03
cesium-135	5.E+02	4.E+04	8.E+06	3.E+02
cesium-137	4.E+01	3.E+03	6.E+05	2.E+01
cobalt-60	4.E+03	1.E+03	1.E+06	7.E+02
euroeuropium-154	2.E+04	3.E+03	2.E+06	1.E+03
euroeuropium-155	3.E+05	3.E+04	3.E+07	2.E+04
hydrogen-3 (tritium)	3.E+08	4.E+05	2.E+08	2.E+05
iodine-129	4.E+04	3.E+04	6.E+06	6.E+03
iodine-131	1.E+04	5.E+03	2.E+06	9.E+02
plutonium-239	2.E+02	6.E+03	2.E+05	6.E+03
radium-226	4.E+00	1.E+02	8.E+03	5.E+01
radium-228	3.E+00	9.E+01	7.E+03	4.E+01
strontium-90	3.E+02	6.E+02	5.E+04	2.E+01
technetium-99	7.E+05	4.E+04	2.E+07	4.E+03
thorium-232	3.E+02	1.E+03	5.E+04	2.E+03
uranium-233	2.E+02	5.E+03	4.E+05	5.E+03
uranium-234	2.E+02	5.E+03	4.E+05	5.E+03
uranium-235	2.E+02	4.E+03	4.E+05	3.E+03
uranium-238	2.E+02	2.E+03	4.E+05	2.E+03
zinc-65	1.E+01	1.E+03	2.E+05	4.E+02
zirconium-95	7.E+03	2.E+03	2.E+06	1.E+03

This worksheet contains benchmarks for radionuclides in water, sediment, and soil.

For each medium, for radionuclide  $a$ ,  $b$ , ...,  $n$ , with concentrations  $C_a$ ,  $C_b$ ... $C_n$ , and for corresponding

$\left[ \frac{C_a}{BCG_a} + \frac{C_b}{BCG_b} + \dots + \frac{C_n}{BCG_n} \right] water + \left[ \frac{C_a}{BCG_a} + \frac{C_b}{BCG_b} + \dots + \frac{C_n}{BCG_n} \right] sediment < 1.0$

End of worksheet